Robots with common sense: Improving sensemaking in service robotics

Other

ROBOTS WITH COMMON SENSE

Improving Sensemaking in Service Robotics

The Open University

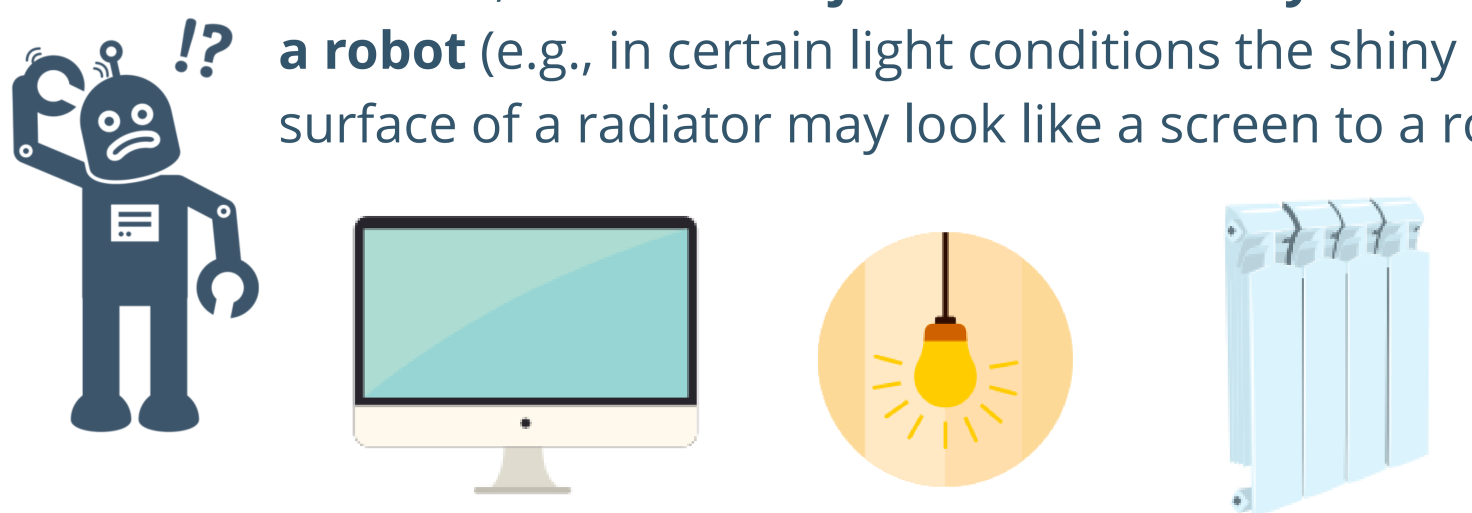
KMi Knowledge Media Institute

Service robots assist humans by performing tasks in a variety of scenarios, including shops, restaurants, healthcare, delivering parcels, accessing hazardous environments, and others.

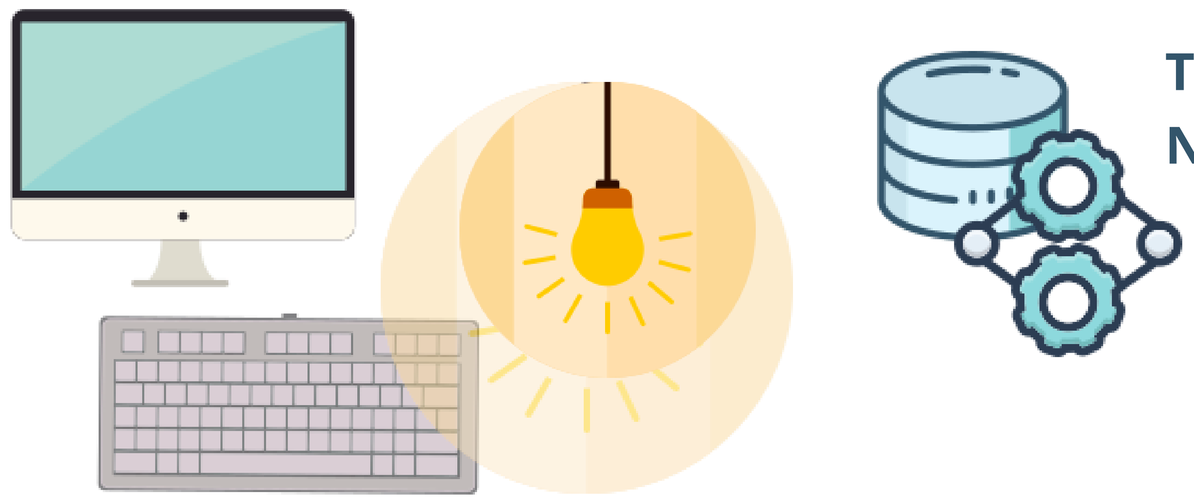
RESEARCH PROBLEM

Service robots need to make sense of complex and fast-evolving environments. They do so by using their **perceptual sensors** (e.g., vision, depth, touch) to **identify the objects** around them.

However, **different objects can look very similar to a robot** (e.g., in certain light conditions the shiny surface of a radiator may look like a screen to a robot)



Hence, **large amounts of background knowledge** are needed to help a robot to correctly interpret the observed scenario.



The shiny object is NEXT TO a keyboard

It is a **monitor, not a radiator.**

PROPOSED APPROACH

- We derived a set of "**ingredients**", i.e., **required knowledge capabilities**, for robots to exhibit human-like performance on sensemaking tasks.
- We identified the types of **common sense knowledge** which enable these capabilities.
- **Hypothesis**: the **integration of common sense knowledge and knowledge-based reasoning with Machine Learning** improves a robot's sensemaking capabilities.
- Our hypothesis is being tested in the case of **HanS, the Health & Safety robot inspector** currently under development at KMi.

MEET HANS!

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Photo credits:
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FOCUS ON VISUAL INTELLIGENCE

Our work focuses on the robot's capability to use its **vision system**, reasoning components and background knowledge to make sense of its environment.

Methods based on Machine Learning have shown promising results.

Nonetheless, machine Visual Intelligence is still inferior to human Visual Intelligence in many ways.

INGREDIENTS OF VISUAL INTELLIGENCE

These were drawn from theories of Visual Cognition and from requirements gathered from our experimental trials.

LEARNING = MODEL BUILDING

NAIVE PHYSICS

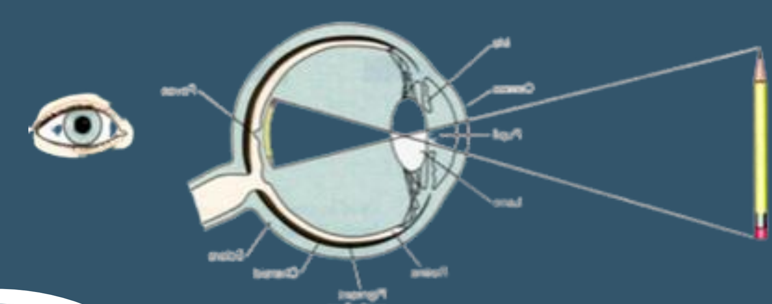
Infants can already grasp basic principles of Physics before 6 months of age.

COMPOSITIONALITY

The human eye identifies the different objects parts and the different nearby objects separately.

FAST PERCEPTION

Our visual perception is extremely fast and we can learn to recognize new objects even from our very first exposure to them.



GENERIC 2D VIEWS

The images cast at the back of our eye are 2-dimensional. We construct the 3D mentally.

MACHINE READING

The ability to read text from images is essential to recognize labelled items and signs.

MOTION VISION

We categorise objects and actions differently based on the perceived movement (or lack thereof).